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# INTRODUCTION OF HARMFUL NON-INDIGENOUS SPECIES INTO THE UNITED STATES

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## RING

Introduction of Harmful Non-Indigenous Species into the

SUBCOMMITTEE ON ENVIRONMENT  
AND NATURAL RESOURCES

OF THE

COMMITTEE ON  
MERCHANT MARINE AND FISHERIES  
HOUSE OF REPRESENTATIVES

ONE HUNDRED THIRD CONGRESS

FIRST SESSION

ON

OTA REPORT ON INTRODUCTION OF HARMFUL NON-  
INDIGENOUS SPECIES INTO THE UNITED STATES

OCTOBER 5, 1993

Serial No. 103-64

Printed for the use of the Committee on Merchant Marine and Fisheries



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(III)



# INTRODUCTION OF HARMFUL NON-INDIGENOUS SPECIES INTO THE UNITED STATES

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TUESDAY, OCTOBER 5, 1993

HOUSE OF REPRESENTATIVES, SUBCOMMITTEE ON ENVIRONMENT AND NATURAL RESOURCES, COMMITTEE ON MERCHANT MARINE AND FISHERIES,

*Washington, DC.*

The Subcommittee met, pursuant to call, at 10:10 a.m., in room 1334, Longworth House Office Building, Hon. Gerry E. Studds (chairman of the subcommittee) presiding.

Present: Representatives Studds, Hochbrueckner, Laughlin, Unsoeld, Hamburg, Hutto, Tauzin, Castle, and Torkildsen.

Staff Present: Gina DeFerrari, Professional Staff; Marvadell C. Zeeb, Clerk; Sue Waldron, Press Secretary; Margherita Woods, Staff Assistant; and Thomas O. Melius, Minority Professional Staff.

## STATEMENT OF HON. GERRY E. STUDDS, A U.S. REPRESENTATIVE FROM MASSACHUSETTS, AND CHAIRMAN, SUBCOMMITTEE ON ENVIRONMENT AND NATURAL RESOURCES

Mr. STUDDS. The Subcommittee will come to order.

What do fire ants, killer bees, and zebra mussels all have in common? Aside from being suitable villains in B-movies, these critters are all harmful non-indigenous species which have found a home in the United States.

What, you may ask, is a non-indigenous species? It is a term of art—or more aptly—science to describe plants, animals, and microbes which are living happily ever after beyond their natural geographic range.

Well known examples include the zebra mussel, which has overwhelmed the Great Lakes and been the subject of hearings and legislation before this Committee; the gypsy moth, which annually defoliates large portions of northeast forests; and the brown tree snake, which has caused millions of dollars of damage and contributed to the extinction of every last native songbird on Guam.

On July 24, 1990, six Members of Congress, including our late Chairman, Walter Jones, John Dingell, and myself, requested the Office of Technology Assessment to conduct a study on the harmful effects of introducing non-indigenous species into the United States; the major pathways for introductions; and the existing legal framework to prevent harmful introductions. OTA has done an exhaustive, and I am sure exhausting, job on its report which is getting its public release here today.

And, while I do not want to steal the thunder of our witness, let me highlight two of the more amazing OTA findings: First between 1906 and 1991, 79 non-indigenous species caused \$97 billion in damage; second, 15 potentially high-impact non-indigenous species may cause \$134 billion in future economic losses. What is more startling is that these staggering losses reflect only the tip of the iceberg.

This is not displayed as a poly-syllabic or almost incomprehensible academic matter. It consists of non-native, exotic, whatever we chose to call them. This is a very, very major and very, very expensive problem that requires our attention.

**Mr. STUDDS.** Are there additional opening statements?

[The statement of Mr. Ortiz follows:]

**STATEMENT OF HON. SOLOMON P. ORTIZ, A U.S. REPRESENTATIVE FROM TEXAS, AND CHAIRMAN, SUBCOMMITTEE ON OCEANOGRAPHY, GULF OF MEXICO, AND THE OUTER CONTINENTAL SHELF**

Mr. Chairman, I want to thank you for holding this hearing today on a very important topic. Exotic species have become a real environmental and economic threat to the nation. In the marine environment alone, these species have cost billions of dollars in prevention measures, clean up and other expenses. The zebra mussel has been a highly publicized example of this, clogging water intakes and forcing billions of dollars in removal and disposal costs. The zebra mussel has continued to spread, even with preventive measures and educational programs in place to prevent this. In fact, the zebra mussel has spread south, down the Mississippi, and now threatens the waters of Texas.

Less attention has been paid to the indirect effects of exotic species. Introduction of non-indigenous species can upset the ecological balance in aquatic systems, potentially altering the food chain and interfering with commercial fisheries. The sea lamprey, alewife, rainbow smelt, white perch, river ruffe and common carp are all examples of exotic species which have disturbed local environments and contributed to the decline of commercially important fisheries.

Clearly, this is a problem which needs additional attention and I commend the Chairman for holding this hearing. The release of this report today is an important step in considering options which will provide for effective mitigation of existing infestations and to help to prevent future introductions. I hope that we can work together as the Committee continues to address this problem. I would be particularly interested in the possibility of holding future hearings to address the effectiveness of the existing prevention and control mechanisms which are in place to protect the marine environment.

**Mr. STUDDS.** If not, we will proceed to our only witness, that is to say, institutionally, it is the Office of Technology Assessment to present the study. I understand Dr. Phyllis Windle, who is the project director, will give the presentation. Then a member of her staff will give some specific illustrations.

Director Windle.

**STATEMENT OF PHYLLIS WINDLE, PROJECT DIRECTOR, OFFICE OF TECHNOLOGY ASSESSMENT; ACCOMPANIED BY ELIZABETH CHORNESKY, ANALYST, AND PETER JENKINS, CONTRACTOR**

**Ms. WINDLE.** Thank you. In about 1525, Martin Luther preached a sermon on education. He said, "Send your good people into the ministry, but your best into government, for in ministry it all depends on the spirit, but in government there are many shades of gray and many ambiguities, and for those, you need your finest people."

We are fortunate today that you have already grappled with some of the problems related to harmful non-indigenous species so you are used to many of these gray areas.

But today we would like to paint a more sweeping picture than your 1990 legislation covered. We will be looking at the problem the Nation faces as a whole.

I am afraid we come with bad news today and that is that the economic and environmental impacts are snowballing. But we also have good news. We have found a number of innovative approaches for dealing with these problems. We have found growing awareness of the issue and we have identified a number of improvements that Congress can make.

One of the shades of gray in this area is that many species are beneficial, whether they are crops, sport fish or biological control agents. It is not our intention to restrict the importation or release of these, but the harmful species cost us all sizable amounts.

The troublesome species are rarely eliminated and we constantly find ourselves adding new ones. If you look at the graph to my right, you will see the pattern of growing numbers of non-indigenous species.

They are separated for six different groups of organisms, but the pattern is the same for all: We know that there are at least 4,500 non-indigenous species of foreign origin that have established free living populations in the country.

It looks like non-indigenous species now account for a few percent of the total U.S. vertebrates. In a number of States, non-indigenous plants account for 10, 20 or up to 30 percent of the plants in that State. In Hawaii, at least half of the State's wild plants and animals are no longer native.

As new species are added, their total impact accumulates like compound interest. That is great for a bank account, but not for agriculture or our national parks.

We have only partial economic estimates for many species, but when they are combined, we do come up with that \$97 billion number for just 79 of them in this century. Most of those costs are in direct control costs and direct losses of marketable goods.

Even this \$97 billion figure, however, excludes one of the costliest groups—non-indigenous weeds. Those, we estimate, add another \$3.6 to \$5.4 billion per year in lost crops and herbicide use.

So our *conservative* estimate is that harmful non-indigenous species cost the Nation hundreds of millions of dollars a year. A more *accurate* estimate is probably that they cost several billion dollars per year and more in high impact years.

Populations of many species spread like wildfire in new habitats, but only about 15 percent of the foreign species that reach our doors cause severe harm. At their worst, they cause declines of indigenous species and contribute to their extinction.

We have a few examples here of some of the worst of the pests the country faces now, and I will pass these photographs for you to look at.

Mr. STUDDS. That is just a photograph, is it not?

Ms. WINDLE. There are several photographs, yes.

The introduction of non-indigenous species is most closely correlated with disappearance of indigenous life in Hawaii and on other

islands. Elsewhere, much of the evidence supporting a connection to endangerment is anecdotal or equivocal.

As of 1991, though, the U.S. Fish and Wildlife Service considered that non-indigenous species were a contributing factor in about 25 percent of the listings as threatened and endangered and they were considered the major cause for listing approximately 7 percent of the species.

Even in the mainland U.S., species can be pushed to dangerously low levels when harmful non-indigenous combine with other environmental stresses. This is the case in California where 76 percent of the indigenous fish are declining, threatened, endangered or already extinct.

Some harmful non-indigenous species like chestnut blight, can radically shift the species composition across large areas. Others modify an ecological system's basic chemical and physical features. The end is the same; ecosystems that are transformed into something else.

We have another graph here. Now, most every part of the country faces at least one highly damaging non-indigenous species. Those are maps for nine different high impact organisms. They are in our own backyards.

These clams are from the Potomac River, the Asian clam. The vines you see around us are from the C&O Canal and Rock Creek Park.

When we look at the national distribution for just a few of these high-impact species and when we also examine how many different kinds of organisms are effected and how many different kinds of non-indigenous species there are, together we have a warning sign of growing impacts.

The threat of new introductions is ongoing, as you know from discussions about releasing the Asian Black carp to control zebra mussels. Most organisms arrive with human help, whether as an unintended contaminant in shipping or as an intentional import that escapes from intended confinement or as a seemingly desirable species that turns out to cause unexpected harm.

Since 1980, we know that more than 200 foreign species were first introduced or detected in the country and at least 59 of these are expected to be harmful. This leads us to the worst case scenario figure you mentioned, \$134 billion for just 15 of the high-impact species for which we can estimate future potential economic losses.

We may never be able to fully predict the risk of new species. For some, keeping them out is the best strategy. For others, control is actually easier than interception in ports of entry. So aiming for a standard of zero entry is unrealistic and undesirable.

Federal and State laws leave both obvious and subtle gaps in their coverage. Many of these apply also to genetically engineered organisms because they and non-indigenous species are commonly regulated under the same laws.

The Federal Government has responded to these problems with a largely uncoordinated patchwork of laws, regulations, policies and programs. At least 20 Federal agencies are involved, with the Department of Interior and the U.S. Department of Agriculture playing the largest roles.

The agencies' policies are sometimes inconsistent and their implementation inadequate. The State role is especially critical for fish and wildlife with approaches that vary from lax to exacting. But some present exemplary examples and provide intriguing models for the Federal Government.

Increasingly, State and Federal agencies, nongovernmental organizations, agricultural interests, and university scientists all see harmful non-indigenous species as a unifying threat and one that public education and cooperative programs are tools to alleviate.

We find that Congress could take a number of specific actions to improve U.S. management. These could include amendments to the Lacey Act, the Federal Noxious Weed Act to fill gaps and ensure their broad interpretation and to expand the list of species covered.

Congress could require stricter screening for invasiveness for those non-indigenous species used in federally funded efforts. We could provide Federal agencies with more adequate authority for early treatment of emerging problems, direct additional funds to weed management and resource management, and expand environmental education.

We know that better management will save money. It will also conserve resources. But there is another less tangible benefit. The richness of our culture is in the details. Some of our traditions developed here whether they are Navaho rugs in Arizona or Chicago's skyscraper architecture. Others are the equivalent of beneficial non-indigenous species like the New York Philharmonic.

In the same way, the country possesses a rich and unique heritage of plants and animals, and by failing to eliminate the harmful ones, we risk squandering our country's biological heritage.

Thank you.

[The prepared statement of Ms. Windle can be found at the end of the hearing.]

Mr. STUDDS. Thank you very much. I didn't know there were poets and philosophers and theologians hiding at OTA? It was marvelous testimony. I appreciate it. I understand Dr. Elizabeth Chornesky also has a presentation.

#### **STATEMENT OF ELIZABETH CHORNESKY, ANALYST, OFFICE OF TECHNOLOGY ASSESSMENT**

Ms. CHORNESKY. Yes. Thank you.

What I would like to do now is to discuss some of the nuts and bolts details of these species. Before me are the small, delicate shells of two invading foreign mollusks. It is difficult to believe just looking at them that either could cause much harm. Yet they are responsible for economic losses to the power industry amounting to billions of dollars and may fundamentally alter aquatic ecosystems throughout the country.

The first of these, Corbicula, or the Asian Clam arrived by unknown means prior to 1924. This rapidly reproducing animal has since spread to over 30 States assisted, it is thought, by humans moving the clams in bait buckets, boats, aquaria, and for research.

Populations grew explosively in the 1960's and the 1970's with dense accumulations of shells clogging irrigation systems and power plants.

One early 1980 estimate put annual losses to the power industry at \$1 billion per year.

The second shell is from a mollusk you know very well, the zebra mussel. It is thought to have first entered the Great Lakes in discharged ballast, has swept across the country since the late 1980's now occurring in 18 States with no stop to its spread in sight.

Like Asian clams, zebra mussels rapidly attain dense populations, clogging water intake and distribution systems. Experts anticipate its total cost to the power industry could exceed \$3 billion by 2001.

The zebra mussel's environmental impacts are expected to be equally severe. By rapidly filtering water and forming dense, bottom-dwelling populations, it may cause major changes in aquatic communities, including the possible extinction of part of the Nation's rich indigenous mussel fauna.

How have we dealt with these harmful aquatic species? Despite the earlier experience with the Asian clam, the Nation was not prepared to deal with the zebra mussels. Not until about three years after it was established and spreading was the zebra mussel placed on the Lacey Act list of injurious wildlife which restricts its importation.

Congress passed the Non-Indigenous Aquatic Nuisance Prevention and Control Act of 1990 to improve the anticipation of future problems of this type.

But implementation of that Act has been slow due to a lack of appropriations according to the task force created by the Act.

Now, I would like to turn to some harmful species of more terrestrial nature. I will direct your attention to the plants that are piled behind the table. Most of us think of green plants as good and we consider one plant to be pretty much like another. But these viney, non-indigenous plants are causing significant harm to natural ecosystems right here in the Washington area where they are overgrowing and killing trees and smothering saplings and native understory plants.

We shouldn't be surprised by this. Rock Creek National Park, in all, has some 33 invasive plants. They spread from adjacent gardens, root from discarded yard refuse, enter as seed in topsoil or root balls; or were planted in lawn-legume mixtures or were carried in by animals.

Some of the harmful vines before you like Kudzu, also sometimes called the Scourge of the South, are well-known. Others like English Ivy and Japanese honeysuckle are more usually considered to be useful in ornamental horticulture.

These illustrate how much the perceived effects of a non-indigenous species can vary with the eye of the beholder.

Even Kudzu was originally promoted for erosion control, although the very features considered beneficial then, rapid growth, ease of propagation, and wide adaptability, cause it to be seen as a pernicious weed today.

This duality, where a species has both positive and harmful impacts, characterizes many non-indigenous species. It complicates the decisionmaker's role.

Deciding whether and how a species can be used becomes problematic when the economic benefits are clear, but the harmful impacts on national ecosystems defy easy analysis.

It may account for why various government agencies and private organizations continue to promote plants that can invade natural areas for applications like soil conservation.

How are we doing with the weeds of natural areas? Few States have moved to protect their natural area from nonagricultural weeds. The approach at the Federal level has been somewhat disjointed. Some agencies have control programs for certain problem species, but many are not currently listed under the Noxious Weed Act and therefore not subject to Federal restrictions on importation and interstate transport.

I would like to close by saying that the United States unfortunately has had a lot of experience with harmful non-indigenous species. Although they have exacted a significant toll, they also provide a wealth of data. These point the way to key questions that will need to be asked before future introductions.

[The prepared statement of Ms. Chornesky can be found at the end of the hearing.]

Mr. STUDDS. Thank you very much. It is a very valuable report and very skillfully summarized and a little bit frightening when one first contemplates it.

I gather from what you said that there are environmental ramifications as well as the economic ones that you highlighted in your testimony.

You warn about the spread of exotic species leading to a highly homogenized world which you call biological sameness in your report. What is that really and why is it a bad thing?

Ms. WINDLE. In some ways, it is like the way we see so many of our suburban areas around the country looking very much the same from one place to another.

Mr. STUDDS. That is a bad thing.

Ms. WINDLE. We do often lack quantitative measures in environmental impacts simply because they are very difficult to measure.

Biological sameness is a bad thing for the same reasons that biological diversity is a good thing. The loss of diversity in the country and the world can occur through the loss of indigenous species or through the addition of ones that many areas share in common—ecosystem diversity rather than species diversity.

For a number of reasons, we as a Nation and as a member of the community of nations have decided that biological diversity is worthy of protection. Some of these reasons are the potential uses of so-far untapped species that might have economic benefit, maintaining a reservoir of species that might be capable to responding to new environments such as those we might experience from global climate change, ensuring that the environmental support functions that support all life are sound, and also increasingly aesthetic reasons. Cultural and ethical motives indicate the irreversible loss of unique life is not always acceptable.

Mr. STUDDS. Well stated. I hope we can find a better name for these critters. "Non-indigenous" is not easy for the average soul to articulate.

Let me go from the general to a specific. You say that non-indigenous species have been a contributing factor in the listing of endangered or threatened of some 160 species and they are the major threat to 41 species that actually are listed as endangered.

Then you go from that to a specific example of a potential problem. As you know, and it has been in the news recently, there are some private fish farms in Missouri and Arkansas that have been breeding black carp, a species raised in China in the hope that it could be used as a biological control agent for another non-indigenous species, namely the zebra mussel.

Some biologists are concerned that once these black carp are released into the environment, they will also feed on endangered freshwater mussels and clams which constitute some of our very most endangered species.

Can you tell us, how serious is the threat of black carp to those already endangered species and what, if any, authority does the Federal Government have at the moment under current law to deal with that threat?

Ms. WINDLE. We were forewarned of your interest in the black carp.

Mr. STUDDS. Excellent staff work.

Ms. WINDLE. In my written statement, there is a summary of what we know about the carp. We also today happen to have part of the jaw and the teeth of the black carp which I think you will find very impressive.

Mr. STUDDS. How big is that creature?

Ms. WINDLE. It can be as big as 150 pounds, but that is unusual. I think it averages 55 to 65 pounds. We have almost 300 native mollusks and about 70 percent of them are either endangered, threatened or of special concern because of declining numbers.

We know that the black carp seems to enjoy eating mollusks, but we have no good information on which kinds it prefers. It might very much prefer the zebra mussels or it might not. So there is always the danger that it would feed, in addition to feeding on the zebra mussels, on some of these native species.

Let me also introduce Mr. Peter Jenkins. Dr. Chornesky and Peter both worked closely with me on our study. He knows a great deal on fish and wildlife and the State laws.

I will let him respond about the adequacy of regulation.

Mr. JENKINS. We did a fairly comprehensive survey and analysis of State laws that address fish and wildlife releases and the black carp is such a case. We found that in some States there would be effectively no regulation of black carp releases.

In other States, there would be some regulation but it would not be held to a very high standard. That is, that the State decision-makers would not be required to do an environmental impact statement or any prior studies of what the effects would be.

In a few of the more strict States like Hawaii, for example, there would be some very intensive scrutiny required before that sort of release could happen.

As far as the Federal handle on that issue, Mr. Chairman, unfortunately it seems to me that under the Endangered Species Act, the handle is fairly weak. Unless there was very strong evidence showing that this creature was going to take an endangered spe-

cies, the Federal Government would not be likely to go in under the Endangered Species Act and deal with the problem until after it had occurred and became an enforcement issue.

One potential solution to that, one option, if you will, is to look at requiring even private and State people to go through a Section 7 consultation under the Endangered Species Act before introducing a fish, or a game animal for that matter, something that might pose a threat to indigenous species.

Mr. STUDDS. I will ask the members to respect the five-minute rule. There are so many here. There is something about this jaw. There may be a future in black carp dentistry. These look like human teeth. This is a cruncher, I assume, to crunch the shellfish.

The gentleman from New York.

Mr. HOCHBRUECKNER. Thank you, Mr. Chairman. That is very interesting testimony. Let me draw a parallel. With modern transportation today, we have a major concern as we have had for many years with regard to the introduction of animal diseases into this country. Of course, diseases like Foot and Mouth Disease, African Swine Fever.

So we have in place centers that in fact do study these diseases like Plum Island and Atlanta among others, to make sure that we can understand these diseases and can take quick action should there be an outbreak. The world being as small as it is today, people can travel around the world in a day and bring in various diseases.

Obviously, the parallel here, as we have a concern that people can easily bring in bugs and plants and other non-indigenous species that can be harmful as well as helpful.

In your study, you indicate that there are roughly 20 Federal agencies that are involved in looking at this problem and it is a disjointed kind of situation.

My question is: What resources do we have? Are there any particular labs that you found or agencies that you found in your research that are specifically dedicated to studying these non-indigenous species to determine what their impact might be if in fact they are turned loose in this country? And also, what can we do to stop them?

Are there any particular agencies you can cite that seem to be the lead agencies based on your research?

Ms. WINDLE. So far, you have in your hands only the summary of our report. On October 13, you will have the whole volume available at 300 pages. We include a primer on Federal responsibilities and policies in there and describe different agencies.

I think you will find that the Animal, Plant and Health Inspection Service is one of the main players for animal diseases, especially as these affect livestock. Fish diseases are not so well covered. That is an area that we found certain gaps in.

Also, even certain human diseases seem to fall through the cracks when there is a non-indigenous species that is a vector.

Liz, do you want to add anything?

Ms. CHORNESKY. There is a Fish and Wildlife Service lab that deals with exotic species down in Florida. Its responsibilities are changing right now and it is not clear what proportion of their efforts will be devoted to that in the future.

A number of USDA labs deal with agricultural pests. Plants, by and large, are not evaluated for pest potential prior to release. That is another one of the gaps we have identified, although plants are studied extensively for use in breeding and other kinds of applications by the Federal Government.

Mr. HOCHBRUECKNER. Does your report contain any specific recommendations as to who you feel, having researched this, should be the lead agency and what their tasks and charter should be?

Ms. WINDLE. No. As you probably know, OTA does not provide recommendations. We say we set out options for you to consider and make your choices. We have discussed in some detail the responsibilities for handling non-indigenous species in natural areas which seems one of the largest areas of gaps.

The coverage of diseases, including fish diseases, really is a new area for authority. That probably needs to be added, but more importantly, it is a question of conducting oversight on implementation of these labs and the other facilities that exist. We do have some suggestions on those.

Mr. HOCHBRUECKNER. With the modern transportation and the concern that these species can be brought in, does your report suggest any ways in which we can improve our ability to put up barriers to these non-indigenous species?

Ms. WINDLE. Modern transportation, as you identified it, is a significant problem. That is something we face that people did not face to the same degree years ago. There was one study of the Los Angeles Airport showing there were about five smuggled plant or animal products coming in on each flight they examined.

We looked at possibilities for better environmental education, for passengers and for the crew on such flights. Also are examined the possibility of labeling certain potentially risky organisms at their sites of origin before they are shipped so that the consumer at the retail level might be better aware of their risks.

There are a number of new ways of detecting organisms, new technologies for detecting illegal or unintentional species that come along with baggage. The beagles that got such a bad play in the Washington Post are actually being used very successfully to inspect for soil and other problem imports at nine airports in the country.

Mr. HOCHBRUECKNER. Thank you.

Mr. STUDDS. I will try to respect the Committee rule of recognizing members by alternating party affiliations.

The gentleman from Massachusetts.

Mr. TORKILDSEN. Thank you, Mr. Chairman.

A lot of the emphasis seems to be on what steps we can take to prevent further introduction of non-indigenous species. Are there any realistic steps that you can see to control non-indigenous species that have been introduced?

Are we trying to fight the tide once a species has been introduced? I noticed the gypsy moth and the purple loosestrife are quite predominant throughout New England and I am sure elsewhere as well. Are there any realistic alternatives or are we pretty much going to be in a constant battle once a species has arrived?

Ms. WINDLE. The introductions we have already had are a significant problem as you identify. The ones you named are some of the

biggest problems in the State of Massachusetts, also a large number of non-indigenous weeds in your crop plants there.

There has been some tendency for some of the Federal agencies to not respond very effectively for a number of already introduced problems. Certainly there are effective programs for the boll weevil and some of the others. The Forest Service has a massive program for gypsy moth control and research.

I think one of the things we emphasize about new introductions is getting after them very quickly so they don't become the kind of widespread problems that we have with so many.

Those that are here, we will probably have to keep controlling—an expensive proposition to control them.

Liz might have something to add.

Ms. CHORNESKY. I think one of the big issues is, of course, rapid reaction. Sometimes that does work. In the case of the Asian gypsy moth that came in, in the recent past, there was rapid effective action by Federal and State authorities to eradicate the infestation.

An important part of that was the monitoring to detect this once it had been introduced. An additional area we looked at is some new approaches to control. In some cases biological control may be a method that can deal with some of these species that are widespread and difficult to eradicate directly.

For example, some of the noxious weed infestations on Federal lands in the West are very difficult to get to because they are way out in the wild blue yonder, but if you release a biologic control agent, presumably it can spread and do effective control even beyond the initial site. That is an additional approach to control that is possible.

Mr. TORKILDSEN. The Mediterranean fruit fly on the West Coast many years ago drew attention as soon as it was discovered. Were those efforts even reasonably successful? I have not seen a status report in the news after the original flurry of reports several years ago.

Ms. WINDLE. California has been very active in this area. They have their border inspections. They have been very assertive about inspecting things that come in through First Class mail, experimenting with ways to tackle that.

It is probably because they have had such expensive experiences like with the Mediterranean fruit fly and several other related fruit flies. I think probably the largest expenditures were back in the 1980's.

They are doing much more for early detection these days. They have traps set up in many areas and try to make sure, if they see new infestations of the fly, they get them very quickly. I think that is fairly successful.

Some people claim that the fruit fly has been established in certain areas, but that is very contentious.

Mr. TORKILDSEN. Thank you, Mr. Chairman.

Mr. STUDDS. The gentleman from Mississippi. Does he wish to do battle with the southern scourge before him there?

Mr. TAYLOR OF MISSISSIPPI. No, Mr. Chairman, but I notice you listed the boll weevil as one of those species that needs to be eradicated.

Mr. STUDDS. I didn't do that, OTA did.

MR. TAYLOR OF MISSISSIPPI. I understand that what you are doing, you know, when you consider trail loads of cocaine are coming in, shiploads of marijuana, how difficult it must be to keep some of these species out of the country.

My question is along the line of what has been done to take advantage of quite possibly some good side-effects of these plants. I know NASA had a Dr. Wolverton who spent a pretty good amount of Federal money looking at good uses for water hyacinths, for example, and found they had were particularly beneficial for removing heavy metals from the water.

I wonder if someone would take a look at the zebra mussels or the melaleuca tree to see if they could be used as a natural means of water purification treatment, in particular, wastewater treatment plants. If one is so good at filtering water and the other so good at soaking up water, there has to be some good use to be made of it. I wonder if the agencies have considered that at all.

MS. WINDLE. There often have been proposals for finding beneficial uses of many of these species, exactly as you say: water hyacinth, Kudzu, melaleuca, a number of others. It appears that the proposals never really get off the ground. There may be one person who is very interested and very committed and really sees the possibilities there, but for some reasons, it really doesn't seem to take off.

I suspect one of the main reasons might be that so often the species are not as dense as in a field, so it is hard to crop them. It would be hard to cut down melaleuca, for example, in the Everglades. It might not be economically feasible, the same way you can crop pine trees, for example.

So it appears none of these efforts have been very successful and I am not quite sure why.

MR. TAYLOR OF MISSISSIPPI. May I interrupt?

MS. WINDLE. Yes.

MR. TAYLOR OF MISSISSIPPI. I have been told by some Floridians that they grow extremely fast and soak up a great deal of water in a day. I would think the crop would be a very small side-effect. If you can filter millions of gallons of water a day using these trees, for example, then at some point when you are harvesting, that is just great.

For example, in our hometown, I guess our treatment pond is 60 to 70 acres large. If you could put half of that in the stand of these trees, I would think you have gone a long way toward filtering your water.

The same thing with the zebra mussels. I understand the biggest problem on the Great Lakes is that they are so effective in water filtration that they are destroying the opportunity for a number of other species to live.

That may be bad on the Great Lakes, but if you introduced an enclosed system for water purification, I would think that would be great.

I wondered again what efforts were being done. I would certainly encourage you to find some good uses for some of these species because we know wastewater treatment has become a very, very expensive program with the Federal Government cutting back extensively on the amount of money they make available to the States

and local communities. I think the match has been dropped from the 90 to 80 and in some cases down to 50 percent.

The cost to local communities is the maintenance of these plants. Whatever we can do to encourage natural filtration as opposed to the cost and electricity to run the pumps and the maintenance on the pumps would certainly be a benefit to everyone.

Ms. WINDLE. A couple of things occur to me. You are certainly right that the State and local governments are under more pressure with the Federal Government dropping back in some ways. Liz can follow up a little more.

I believe the proposals in Florida were to use melaleuca for wood, not for water filtration. The biggest problem I guess I would see in using zebra mussels for water filtration is that it is so difficult to confine these species.

If the melaleuca started spreading to private homeowners' land and replacing all their trees, which is sort of what melaleuca does in the Everglades, the local governments might have bigger problems on their hands than they thought.

Did you want to add something about melaleuca?

Ms. CHORNESKY. I have heard about people thinking about using zebra mussels as a water filter. The trick is making sure there are things in place to prevent escape in advance. Often, when we consider using species that are potentially harmful, they have not given adequate consideration to prevent the release.

We find a large number of weeds are actually escaped ornamental plants or escaped crop plants where people didn't think they would be harmful later on.

Mr. TAYLOR OF MISSISSIPPI. Could I interrupt? I understand what you are saying, but it seems to me to be a very simplistic approach. In the last stage of almost every water treatment plant is the filterization process. You say the water treatment kills zebra mussels. Again, I would certainly encourage, since we are going to spend the money anyway, to try to find something good out of all of this rather than just cursing the darkness, as they say.

Ms. WINDLE. Thank you. I think you are right.

Mr. STUDDS. The reference was certainly not to the vertebrate form of boll weevil.

The gentlewoman from Washington.

Mrs. UNSOELD. Thank you, Mr. Chairman.

I want to talk about something with which I am a little more familiar, something called spartina. In the intertidal areas of Washington State, there are many areas that are being invaded by three exotic species of cord grass all known as spartina.

The result has been massive habitat alteration and significant impacts on local fisheries. For example, on Willapa Bay, the area that has been taken over, in 1984 there were 430 acres of spartina and it is predicted that it will cover 30,000 acres of the bay by the year 2030.

Concern has been strongest in this very area of Willapa Bay where spartina is expected to cover, as I indicated, a very, very large amount. Now, that is the same area that is currently a very good shell fish producer and also for crabs.

The U.S. Fish and Wildlife officials are concerned about the loss of habitat on the Willapa Wildlife Refuge and the county officials

and the oyster industry see it as a threat to the local economy as well as to the environment.

What has been done or should be the Federal response?

Ms. WINDLE. I am going to ask Peter as a former indigenous person to Washington State to help with the answer. Spartina is a very interesting case because it is native to the East Coast of the United States.

Mrs. UNSOELD. When I first arrived in Congress and went to one of the Appropriations Committees and asked if we could get some money for a study for such a nuisance, they said, "We plant it."

Ms. WINDLE. I did my graduate work at the University of Georgia. Its marine laboratories are noted for their research on spartina, and the natural spartina marshes on the East Coast. It is a very interesting case, too, because we see such interesting changes in the patterns by which non-indigenous species spread.

Formerly, species spread around the ports, but now we see species jumping from the East Coast to the West Coast and back again. I will let Peter answer the question about what needs to be done, the tough one.

Mr. JENKINS. As you know, the Washington State Department of Agriculture responded. I think that spartina invasion forced them to consider other species, as well, that were potential wetlands invaders.

Mrs. UNSOELD. We have to go beyond identification.

Mr. JENKINS. Another thing that is happening is the privately initiated Nature Conservancy response that incorporates some of the other economic and environmental concerns in that area, but also focuses on the spartina.

Again, you know more about the specifics than I, but those sorts of interagency private-public State models are really a good way to go in response to other questions.

Mrs. UNSOELD. I believe you would find that although they are buying up some land, no one has a theory yet on what they ought to do to try to control this. They are concerned also that what we have bought to have for refuge purposes, that that ability for birds and other life to use may be lost.

Mr. JENKINS. In terms of specifics of a Federal response, some of the things would go along the line of improving the Federal Noxious Weed Act. We have outlined a number of options as far as what Congress can do to improve that Act to prevent future problems like that from happening and also to steer more Federal efforts into controlling those sorts of infestations.

Ms. WINDLE. Control of plants and other organisms in wetland areas is particularly tough because there are so few herbicides that are registered for use there and it is a difficult area in which to use herbicides.

I know in Kampoosa Bog, which is in Massachusetts, they are concerned about controlling phragmites and they are thinking about using Round Up there. The melaleuca control in Florida has grappled with some of the same issues and they are using chemical controls that need to be done repeatedly.

The only other solution in some cases is hand pulling these plants and that is not a viable alternative in the large area you are talking about, especially without disrupting those shell fish beds.

The Agricultural Research Service has had a program to develop biological control agents for a number of aquatic weeds. That has been cut back. To my knowledge, they are not doing anything on spartina.

Mrs. UNSOELD. And you are not doing any specific research on control?

Ms. WINDLE. No.

Mrs. UNSOELD. Would you if you had money?

Ms. WINDLE. We tend to do sort of secondary research. Probably the executive branch agencies would be the first line of defense on this one. We also have a biological control project that is just getting under way. That might be looking at some of these issues.

Liz will be the project director on that. Do you want to add anything?

Ms. CHORNESKY. That is just getting under way, starting in January probably with a delivery in mid-1995. We have been asked by the House Agriculture Committee to look beyond applications to agriculture, to also application to natural areas. So that might be an area that we will get into.

Mr. STUDDS. So that members know the sequence we are going in, we will recognize in the following order: Messrs. Hamburg, Castle, Laughlin and Tauzin.

The gentleman from California.

Mr. HAMBURG. Thank you, Mr. Chairman.

My question is going to be around a specific example in the California water system, specifically in the San Joaquin and Sacramento River system.

With respect to the striped bass which was introduced apparently almost by accident or at least very serendipitously into the California river system in the late 1800's, today these are considered a desirable game fish.

The California Fish and Game planted striped bass in the estuary for many years. It is now an important part of the sport fishing industry and an important part of the economy of the State.

My question: The California Department of Fish and Game has now curtailed that program because of the conflict between the striped bass and indigenous species of salmon, particularly the winter run Chinook is considered to be in competition with the striped bass.

So here we have a situation where we have a non-indigenous species which is a well-known species and very valued species and I think even a threatened species in some parts of the United States where it has been introduced in an area where it is non-native, and we have conflicts with the whole support fishing economy and even a conflict with the Endangered Species Act with respect to the winter run Chinook and maybe other runs of salmon as well.

I want to ask how the findings of the OTA deal with this kind of situation. I guess part of the question is what is the definition of an exotic species? Is the striped bass going to be included in this species because, in this case, it is beyond its natural range. I think we can start with that.

Ms. WINDLE. You have put your finger on a number of the gray areas. By our definition, yes, it would be considered exotic or a non-indigenous species because we think it is particularly important to

include not only species that are foreign to the United States, but also those that have spread beyond their natural range into other parts of the U.S. such as the spartina, for example.

The State of California's Fish and Game Agency is very much in line with what many other State agencies are doing and that is responding to increasing pressures to be more careful about the introduction of non-indigenous species and to start limiting some of the ones that are threatening indigenous ones.

Peter, do you want to add something on that?

Mr. JENKINS. I think that the fishery situation, especially in California, as Dr. Windle said earlier, is a difficult one because there are so many threatened and endangered species there and, of course, you have a very powerful constituency to preserve the salmon for the economic, recreational, and aesthetic associations with the salmon.

That, in a way, is almost an easier problem, I hate to say it, because there you have a very popular indigenous species on one side against a popular non-indigenous species. What is really difficult is when you have a popular non-indigenous species on one side. And the indigenous species may be a clam or something that does not have many economic, recreational or other benefits.

I think in that case the value of the salmon would be a very important factor.

Mr. HAMBURG. I guess in that case it gets into the definition of who is being harmed. Is it the indigenous species and how do we factor in the whole economic issue in here.

This is something that I know my colleague from Louisiana sometimes discusses in his concerns about the Endangered Species Act and how we factor in the human factor here. I think the sport fishing economy is an example.

Another one is on the Eel River where we had the introduction of the Squaw fish which is now out-competing the salmon. I think that was introduced originally in order to be of some benefit. I don't know if it was to be a sport fish or whatever. I know it has kind of taken over and is really hurting the attempts to bring back salmon into the Eel River system.

Ms. WINDLE. Some of the findings that our report discusses relate to the decisionmaking process. Those are directly related to the issues you are raising, how we decide how much risk is acceptable, which kinds of values will take precedence, making those sorts of choices, and resolving disputes among interest groups.

It is interesting to take a look at our track record on introductions. We found that for fish, in particular, the species that have been intentionally introduced with the understanding that they were going to be beneficial have caused harm a little bit more often than those that have been unintentionally introduced.

That is not a very good track record for thinking about new introductions such as the black carp. I think partly it is that greater understanding of the number of fish that have been harmful that is leading many State fish and wildlife agencies to back off.

Mr. HAMBURG. They are taking a more conservative approach to try to alter the system to do something good.

Thank you, Mr. Chairman.

Mr. STUDDS. Perhaps we could enter into negotiations for the return of the striped bass to the East Coast.

Mr. HAMBURG. I would be glad to help with some of them.

Mr. STUDDS. The gentleman from Delaware.

Mr. CASTLE. Thank you very much, Mr. Chairman.

You may have mentioned this earlier and I missed it, but what percentage—and there is a lot of types of species we are dealing with here—but what percent of these kind of things are introduced unintentionally versus intentionally.

I understand there is some sort of a court of review that looks at everything. It is not quite that simple. These seem to go across the United States for various uncontrolled reasons and get introduced. Does anyone have a handle on that at all?

Ms. CHORNESKY. Trying to get a handle on the pathways of entry of these species is a very difficult thing because we know there are a lot of them but nobody keeps count. One thing we do have in our study is a list of species that were introduced or detected since 1980. Assembling that list was difficult. It is, undoubtedly, not comprehensive.

Proportions vary for the insects, a large proportion of them are unintentional introductions. However, we have had increasing numbers that are intentional.

For fish and wildlife, the people we spoke to could not come up with new introductions of vertebrates since 1980 so we did not have them on the list. We did not locate them during our research.

I think there were eight or nine new fish. Those were approximately 50/50 intentional versus unintentional. That gets at the definition of intentional versus unintentional. Some were thought to be dumped from aquaria by individuals. That is ambiguous whether it is intentional or unintentional.

Mr. CASTLE. But it is uncontrolled; whether it is intentional or unintentional, it is uncontrolled.

Ms. CHORNESKY. One thing that we are seeing in the area of fish and wildlife at this point is increasing transfers of species around the country. This is another place where the definitional inconsistency becomes a problem because those are not considered by some people to be new introductions even though they may be introduced to a new location. I guess what I am saying is that it is very complicated to try and get a handle on it.

Mr. CASTLE. The bottom line is, we will never be able to control all of this even if we want to. The government cannot just simply control all these things in terms of an insect coming across the waters or whatever it may be. I agree with you.

It is like a lot of government. It is a policy patchwork as you say here. It is very confusing in terms of the jurisdictions of various agencies, the laws and regulations, definition even as they apply.

You also said you do not provide recommendations; you just set out options. I don't like that answer. It seems a little bureaucratic.

Ms. WINDLE. Talk to my boss who is here.

Mr. CASTLE. We need to talk to your boss. Is there some way we can simplify all of this, have Vice President Gore touch on it in reinventing government? Are there things that we should do as a committee?

Based on my limited knowledge in this area, it is very, very confusing in terms of what you are doing, what you have to do and how you learn about what the various things may be.

If all of us are confused, you can imagine how the average person out there trying to deal with this particular problem. That is true of all government not just this particular area.

Is somebody looking at something more than just what appears in the Act of 1993 or 1994 or the Act of 2000 or whatever, but looking at trying to come to grips with this problem and putting it in one place at one time with one set of rules and regulations?

Ms. WINDLE. I don't think there is that movement right now. There seems to be a consensus that we don't really have a national policy on non-indigenous species and have not tried to have one since President Carter's 1977 executive order.

It seems possible that comprehensive new legislation might treat this area. But it also looks to us like a number of the laws are relatively complete and small changes might be very helpful.

We talked about the Federal Noxious Weed Act, the Lacey Act, the Federal Seed Act and the National Environmental Policy Act, where just a few changes more on the order of tinkering might really help the situation.

I think we are probably more concerned about awareness and implementation of the executive agencies. That is more a question of oversight than sweeping new legislation.

Certainly we have identified what we consider the big problem areas and have highlighted the issue of screening new introductions, of better control on public lands dealing with problems of the National Park Service. These are all quite specific areas that we have addressed and see that there could be a lot done that would be helpful.

Mr. CASTLE. Thank you. Thank you, Mr. Chairman.

Mr. STUDDS. I suppose someone will have to look at that executive order from President Carter. I don't know that it was ever implemented. It was directed at the Federal agencies and not at the aforementioned critters; right?

The gentleman from Texas.

Mr. LAUGHLIN. Thank you, Mr. Chairman.

Ms. Windle, on page 2 of your testimony, you point out if you represent an agricultural district, your constituents have shared in a \$3 to \$5 billion annual loss. If you represent a district with a game refuge in it, you had substantial loss there.

In South Texas, I represent a very large agricultural district, plus I have five game refuges contained in the district I represent. You go in your report and point out that across the street on the beautiful grounds of the United States Capitol, over 50 percent of the shrubs and trees over there that so beautify these grounds are non-indigenous species.

So I see the conflict in your testimony, and what you are telling us is that there are some bad critters which we know in south Texas as the Fire Ant, the Boll Weevil, killer bees, probably even Nutria which was introduced for good cause and has created interest.

Then you come along and tell us there really are some wonderful things that are non-indigenous. How do we in this Committee de-

termine what is good or what is bad? Do you have a procedure? Is there testing? How do we determine what is good and what is bad in all these conflicts that we have?

Ms. WINDLE. Well, you have put your finger on the way that so much of this is gray. There are some species that are clearly harmful and there are others that are clearly beneficial. There are others that fall in a gray area. They might be beneficial in one place and harmful in another.

There is no easy way to pin down a label for many species. We are stuck with struggling with this ambiguity even in our Federal agencies because the Fish and Wildlife Service, the managers of those national wildlife refuges, some parts of the agency are responsible for enhancing certain non-indigenous species and others for controlling the ones that are harmful. I am afraid it is a problem that comes with the territory in this case.

People have turned to more rigorous decisionmaking approaches as one way of trying to sort out some of these questions, trying to sit down, having expert output, to predict the potential dangers of some of these species, to look more carefully at what might go wrong so that we are not surprised when a species that looks good turns out to be bad.

Mr. LAUGHLIN. I understand when you have something like the bees that came across the border like we experienced in Texas. When you have the black carp and when you have the various Nutria and other things that are introduced intentionally, are your people trying to determine some test periods, some review so that the intentional decisions can be measured and determined whether we are doing harm or not?

Ms. WINDLE. It was our job to evaluate how well the executive agencies are doing that job for us. USDA is fairly rigorous now in how it screens certain imports. It has a more explicit risk assessment approach.

The Fish and Wildlife Service does far less about assessing these potential risks. They are the agencies that we have to turn to, to be responsible for these decisions about imports.

Mr. LAUGHLIN. As a suggestion, if you would notify the Fish and Wildlife people that you were going to transfer that jurisdiction to the Agriculture Department, I would imagine they would put in more emphasis and screen it a lot closer, knowing how things operate here when it comes to jurisdiction.

Ms. WINDLE. There was someone here from the Fish and Wildlife Service before. I thought you might want to put him on the spot. But I imagine you are right. Did you want to add anything, Peter?

Mr. JENKINS. I should point out that this is not an easy issue, this question of how we are going to restrict more introductions.

I suspect some of the members with a lot of history here may remember that back in the 1970's the Fish and Wildlife Service tried to do that very thing, that is, to impose very rigorous guidelines on what fish and wildlife species could be brought into this country. There was a terrific uproar from the pet industry, the zoos, and aquariums.

One of the benefits from this report is that it will deal with a lot of those issues that were raised back in the 1970's that never got resolved. When Congress did try to address this issue back then,

the Fish and Wildlife Service came in with recommendations that basically got shot down.

Before you jump into it again with both feet, I think it would be helpful to review some of that history and look at how we have talked about some of those issues in this report.

Mr. LAUGHLIN. My last suggestion is that you ought to add people into that list of considerations. We have had some who have come here who have been intent only on mischief. So we could add some people up here to add to the trees and the birds and the fish and the plants.

Thank you very much, Mr. Chairman.

Mr. STUDDS. Perhaps the Fish and Wildlife person left to go back and implement the 1977 order issued by President Carter which as I understand it has yet to be implemented.

Ms. WINDLE. That is right. It directed all agencies to implement it, but the Fish and Wildlife Service was to serve as the point agency; it has done very little.

Mr. STUDDS. Service in this Congress is not the only frustrating job in this city.

The gentlemen from Louisiana.

Mr. TAUZIN. I hope the gentleman from Texas was talking about noxious critters and not talking about Cajuns or anyone else.

Mr. LAUGHLIN. I want to assure the gentleman from Louisiana I was not talking about Cajuns.

Mr. TAUZIN. You used some language in your discussions with members today that leads me to some questions. You talked about intentional and nonintentional entry of potentially dangerous species into America.

As I read your material in your report, it looks like we have really left it to States to decide whether they are going to permit the intentional entry. The Federal agencies are basically the ones in charge of trying to control the unintentional entries; is that correct?

Ms. WINDLE. Yes and no. Did you want me to add something?

Mr. TAUZIN. I know it is a generalization, but is it generally true that States decide for themselves what plants or animals they will allow introduced into their States and the Federal Government generally works on the procedures to prevent the unintentional introduction across American borders of plants, animals, and other things that might be problems.

Ms. WINDLE. I would say you are absolutely right about fish and wildlife. There the States are the main players.

Mr. TAUZIN. I take it from your report that that is an inadequate system because some States have good systems and some States almost completely lack in their regard for what may be introduced into that State. Is that correct?

Ms. WINDLE. That is also correct. The standards vary quite dramatically.

Mr. TAUZIN. I also note that in your report you referred to the Keystone Center policy dialog that occurred in 1991 which made specific recommendations regarding how to deal with this. It basically recommended an agency-by-agency approach just on public lands. It talked to prohibiting new releases and controlling old releases and maintaining those that are beneficial.

The question I have relates to that approach. I know it has been adopted in the Federal Noxious Weed Act. Is that approach really adequate?

I refer specifically to one of the many cases you cite in your report, the introduction of an opossum shrimp in the Flathead River-Lake ecosystem. I take it that is in Kalispell, Montana. You describe how it had serious effects. You point out like a line of falling dominoes driving away fish predators including eagles, otters, coyotes, and bears. You have a whole series of effects that might cross agency jurisdictions.

If we are going to improve on the Lacey Act and improve on the Noxious Weed Act as a result of this report, can you do it with an agency-by-agency approach or are we going to need some council that literally makes a decision as to how we are going to let nature take its course or not take its course with the introduction or expansion of species beyond the natural range?

My sense from reading this is that the agency-by-agency approach will do the job. Would you quarrel with that? Do you think the agency approach is a good one?

Ms. WINDLE. Let's talk about a couple of different elements of that. Certainly you have identified a problem that exists throughout the government. We see it within OTA. You see it with your committee structure. So many of our problems now cross jurisdictional boundaries and so far it seems like our government has not really found a good way to grapple with those.

One way that has been attempted, as you know very well, is the interagency task force that was created under the non-indigenous Aquatic Information and Control Act. Dr. Chornesky has been following that quite thoroughly. She has attended task force meetings and kept up on their reports. I would like her to talk about the strengths and weaknesses of a task force as opposed to an agency approach.

Ms. CHORNESKY. It has taken a long time for the task force to accomplish its particular tasks that are set out in the Act. In our assessment, there is a table in one of the chapters that lists all the specific tasks they were supposed to do, some of which they have accomplished and some of which they have not, and they have predicted delivery in a couple of years from now, after the intended dates.

We talked with them about what were the reasons why this kind of interagency coordination is a difficult thing. Why did it take them so long to do this?

Mr. TAUZIN. And their response?

Ms. CHORNESKY. What they told us is that, first of all, they had very little money to accomplish their goals. I have heard that that provides the individual agencies with few incentives for participation in the task force.

Mr. TAUZIN. You also have a lot of turf problems, don't you?

Ms. CHORNESKY. I am not so sure that is the problem as much as that the agencies came into the task force with different perspectives on the issues. They almost spoke different languages. In part, that might be traced back to the implementation of the Carter executive order.

Mr. TAUZIN. We need to look at that to see which approach really works and we need to look at the Federal-State relationship. I think if you look at changes in the Noxious Weed Act, that those seem to be rather central to any decisions that were made about grouping the context here.

There is one final thought and that is, if you look at the history of evolution and the great diversity of species on the planet, you will note that very distinct populations of plants and animals and species are found in isolated areas and evolution occurred in different places and different directions. That isolation has ended, as you point out, and, as we come into contact with those areas, Galapagos Islands, Australia, we see the migration of all sorts of things going on.

Mr. Laughlin got to this question perhaps even deeper than that. But now that that is possible, now that all of this is occurring, the isolation of the world has changed. Do we have some international agency that is going to decide how far a species can range? We have changed the nature of nature.

Is there any authority other than our little national authorities to make those decisions on a global basis? Is anything going on in the United Nations?

Ms. WINDLE. There are only a few international treaties that apply here. The main one deals with agricultural pests. The Biodiversity Convention originally had very strict provisions for non-indigenous species, but that was taken out during various drafts and they are not in the version that is signed.

I don't think anybody's minding the store at the level at which you are asking.

Mr. TAUZIN. Thank you, Mr. Chairman.

Mr. STUDDS. That cry of the intellectual heart. I don't think we are going to get the populous in the streets demanding an inter-agency task force somehow. It seems to me unlikely.

The gentlemen from New Jersey.

Mr. HUGHES. Thank you, Mr. Chairman.

I, too, want to welcome the panel. I wonder if we have the ability, even with the environmental assessments that OTA recommends, to really understand the long-term impacts of introducing non-indigenous species.

Quite often, it has only been after a number of years that we determine in some instances the damage that is done. What sort of protocols could we put in place basically to accomplish the kind of prevention that you envision?

Ms. WINDLE. Right now, the major approach the Federal Government takes is what has usually been termed a dirty list, which is we list species we know we want to keep out of the country.

Mr. HUGHES. Those are the clear ones, the ones that are clearly harmful we know about. The ones in the gray area is something else again.

Ms. WINDLE. Right. There have been proposals that we should supplement this dirty list approach by some clean list of things that are also clear, the acceptable ones. But there are a number of things that fall into this gray area, fall into a different regulatory category that have different features for their control and for their assessment before they are introduced.

Peter is our expert on these lists. I will ask him to add a little more about the decisionmaking.

Mr. JENKINS. There are a number of protocols out there that exist. The American Fisheries Society has a detailed protocol designed to give decisionmakers a guide as to whether they should let a new species of fish be introduced. In fact, though, none of the 50 States nor the Federal Government require that the American Fisheries Society protocol be used.

So you cannot eliminate all the uncertainty under these protocols. You still have some uncertainty at the end because, as we say, these are very difficult things to predict. There is a lot we can do to reduce that uncertainty and to make it more clear so the decision-makers know where the uncertainty is.

A lot of the decisionmaking now is seat-of-the-pants stuff.

Mr. HUGHES. Do we have anything in place today that is basically constructed to examine long-term impacts of non-indigenous species? Because, as I understand it, some of it is cumulative and you don't know until it has been introduced.

Ms. WINDLE. I would say that there has been very little attention to this problem for a long time. So even many of the academic experts don't often distinguish between non-indigenous and indigenous species. But I would say that now the kind of research that you are asking about is starting to occur in the universities. We see that with the people who are our expert contractors.

Mr. HUGHES. Is there any mechanism to coordinate those activities so we don't have duplication and we can maximize the research?

Ms. WINDLE. Yes. I think there are increasing mechanisms for that. On Friday, I will be speaking to the California Exotic Pest Plant Council which is that kind of coordinating group.

The key note speaker will be an academic scientist talking about these kinds of long-term questions. It will include a lot of State people as well as Federal and university people.

Mr. HUGHES. Is there any mechanism at the Federal level to coordinate that?

Ms. WINDLE. Some of the Sea Grant programs that are Federal and State programs are serving in a coordinating role about zebra mussels research. Do you know of any others, Peter?

Mr. JENKINS. Nothing comes to mind. I think there has been a feeling that there could be some expert advisory panel, some sort of commission, interagency group that would just work on that very same thing of coordinating information and sharing information, too.

That is another problem. There has been a lot of information that has been developed but it is buried out there in the file drawers of the various people, and this whole subject matter has not been organized as one discipline so people can get access to information. That is another area that can be worked on.

Mr. HUGHES. Thank you.

Mr. STUDDS. We don't have time for a full second round, but I will allow the members if they wish, an opportunity to ask one additional question.

The gentleman from Mississippi.

Mr. TAYLOR OF MISSISSIPPI. If you would, whatever information you have on the melaleuca tree, how fast it grows, how much water it takes in in a day, what types of areas can it live in, is there a market and use for it as far as lumber, poles, pulp, whatever you have on it, I would be very much interested in taking a look at in addition to whatever research you have done today on the zebra mollusk.

We had a hearing a year and a half or two years ago on the subject. I was curious as to what steps have been taken since then to minimize the impact on water lines and water intakes.

Ms. WINDLE. We have quite an extensive library on both of those.

Mr. STUDDS. The gentlewoman from Washington.

Mrs. UNSOELD. Do you get involved in trying to determine whether or not something is indigenous, and more specifically, are you involved in the question of the mountain goats and the Olympics?

Ms. WINDLE. We have had to decide what our definition would be in the course of the study. We have had to evaluate the adequacy of other people's definitions. But we have not dealt with that question in much detail. Do you want to add anything, Peter?

Mr. JENKINS. We did sort of follow the literature up until about a year ago. I don't know what is happening in terms of people coming up with new evidence on those mountain goats.

I understand from recent articles that the Park Service is planning to go ahead and implement a plan to shoot a lot of those goats, so they must have made a determination that they are not indigenous. There you have a very emotional issue.

Mrs. UNSOELD. One faction has decided they are indigenous and the other has decided they are not. I am not sure when the shooting will stop.

Mr. JENKINS. I wish we had an answer to that, but no, we don't know for sure whether they were there or not.

Mrs. UNSOELD. Thank you.

Mr. STUDDS. The goats themselves are probably somewhat uncertain at this point.

The gentleman from Louisiana.

Mr. TAUZIN. Zebra mussels are coming to Louisiana. Out of the blue, on one of the nature shows on television, there is a report on an Ethiopian weed, the extract from the seed of which kills zebra mussels.

Obviously, I don't know what is happening in regard to that interesting report. We have a weed that grows only in Ethiopia, a poor country that could use an export. Here is a product that might be useful in American. Who knows about it? Who allows the entry? Who approves it? Who doesn't? How does that system work?

Ms. WINDLE. I think you are probably talking about Endod?

Mr. TAUZIN. I have no idea of the name. It was just an interesting story. Here is a poverty-stricken country growing a weed that can help solve the very serious problem of the zebra mussels.

Ms. WINDLE. OTA did a study a few years back on innovative biological uses of various organisms. I think it is Dr. Lemma who is an expert with the United Nations on that use. He has pioneered the use of Endod to kill the snails that contribute to the spread of schistosomiasis, if I am right, so it is probably the same plant.

Mr. TAUZIN. You are ahead of me. I saw the report on a nature show. I wondered whether we have an informational base in America where you could find out whether that is in fact being used here and who would control it for the zebra mussels and how would the people in the States know about it.

We are talking about planting trees and other things to control carp and there may be a very simple solution in Ethiopia. Where is more information available on it, and after you have the information, who would approve its entry and use in America?

Would that be the Agriculture Department or the Fish and Wildlife Service since this is an aquatic species we are trying to control?

Let me make an assumption that it is real, the stuff is available. Who in America would say yes, you can use it in Missouri or yes, you can use it in Louisiana?

Ms. WINDLE. The United Nations would know more about it because it is their employee who has pioneered it. There would be some people within the USDA who would also know about it. If it is an extract of the plant to be used, I imagine then we are talking about something similar to a pesticidal approval process, which would involve EPA.

If this is the plant itself, then we are talking about USDA, I imagine, because it might come along with diseases or something else undesirable. So they would come in with respect to quarantines.

Mr. TAUZIN. We don't have a very good handle on all this, do we?

Ms. WINDLE. No, it doesn't look like it.

Mr. TAUZIN. Thank you.

Mr. STUDDS. Maybe we do need an interagency task force. I am worried about the fact that that plant is 3 feet further across the table than when you brought it in today.

When you mentioned in your remarks about escaping ornamental plants, does that mean we ought to close our windows at night or what does that mean? House plants aren't going to get up and start walking; are they?

It has been a long week already and it is only Tuesday. If we are half as good at resolving this problem as we are at identifying it, we will have made remarkable progress.

It is clear that we face a problem of which proportions we are not certain except for the fact that they are large and they are growing. We are certainly not equipped, as the gentlemen from Louisiana's questioning has made clear, to deal with any comprehensive, coordinated, rational fashion. Not that that distinguishes it from any other problems facing us.

I want to thank you very much for a remarkable piece of work. You focused us. You have done your job and now it is up to us to do ours. We look forward to working with you.

The Subcommittee stands adjourned.

[Whereupon, at 11:50 a.m., the Subcommittee was adjourned, and the following was submitted for the record:]

OTA TESTIMONY

TESTIMONY OF ELIZABETH CHORNESKY, ANALYST,  
OFFICE OF TECHNOLOGY ASSESSMENT, U.S. CONGRESS

SUBMITTED TO THE UNITED STATES HOUSE OF REPRESENTATIVES  
COMMITTEE ON MERCHANT MARINE AND FISHERIES

Subcommittee on Environment and Natural Resources  
Subcommittee on Fisheries Management

October 5, 1993

CASE STUDIES OF HARMFUL NON-INDIGENOUS SPECIES



Congress of the United States  
Office of Technology Assessment  
Washington, DC 20510-8025

Thank you, Mr. Chairman. I am Dr. Elizabeth Chornesky from the Office of Technology Assessment. By training, I am a biologist and an ecologist. For the past few years I have been working on the OTA study Harmful Non-Indigenous Species in the United States. I am going to discuss the nuts and bolts details of how some of these species have spread and affected the nation.

#### Invasive Aquatic Mollusks -- the Asian Clam and the Zebra Mussel

Some invading species quickly spread far and wide and, once entrenched, have lasting economic and environmental impacts. The Asian clam (*Corbicula fluminea*) and the zebra mussel (*Dreissena polymorpha*) illustrate these features.

How the Asian clam entered the United States is unknown, but it is believed to have arrived on the West coast before 1924. Since then this small, rapidly-reproducing, freshwater clam has spread to at least 30 States. Experts speculate that its expansion among unconnected waterways was inadvertently assisted by humans moving the clams in bait buckets, on boats and barges, for use in aquaria, and for research.

The clam's dense accumulations of shells clog irrigation systems and power plants. Its explosive population growth during the 1960's and 1970's disrupted the operations of numerous steam and at least three nuclear generating stations -- with down-time, corrective actions, and maintenance costing millions of dollars. In 1980, the Arkansas Nuclear One power plant was forced to shut down because of waterline clogging by Asian clams, prompting the Nuclear Regulatory Commission to require an evaluation of whether fouling by Asian clams posed a hazard at each nuclear facility in the nation; the estimated costs of compliance was \$4.5 million. One estimate in the early 1980's put annual losses to the power industry due to this species at \$1 billion.

The environmental effects of the Asian clam are largely undocumented. Experts believe, however, its high densities exacerbate the threat to native mollusks already stressed by environmental degradation. Recently, some populations of the Asian clam have begun to decline for unknown reasons. Its impacts remain significant, nevertheless.

Another invading mollusk, the well-known zebra mussel, has swept across the country since the late-1980's. It is thought to have first entered the Great lakes by way of discharged ballast water. As of September 1993, the zebra mussel had spread to at least eighteen States and many of the major rivers east of the Rocky Mountains. Zebra mussels adhere by tough threads to hard surfaces like pipes, making the mussels difficult to dislodge. Like Asian clams, they rapidly attain dense populations, clogging water intake and distribution systems. When mussel fouling affects cooling or other critical water systems of power plants, it can necessitate a plant shut down, costing as much as \$5,000 per hour for a 200-megawatt system. Experts anticipate expenses of up to \$800 million for plant redesign and \$60 million for annual maintenance, with total costs to the power industry reaching as high as \$3.1 billion by the year 2001.

Environmental impacts of zebra mussels are expected to be equally severe. The mussels rapidly filter water, decreasing the food available for other animals and increasing light penetration. This, coupled with the zebra mussel's dense, bottom-dwelling populations, is expected to cause major changes in the biological communities found within U.S. lakes, rivers, and streams--including the possible extinction of part of the rich indigenous mussel fauna in the United States.

Despite earlier experience with the Asian clam, neither Federal nor State governments were prepared to deal with the zebra mussel. Not until about three years after it was already established was the zebra mussel placed on the Federal Lacey Act list of injurious wildlife--such listing restricts its importation. Congress passed the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 to improve anticipation of future problems

like the zebra mussel. However, implementation has been slow thus far; a lack of appropriations has stymied progress by the interagency task force created by the Act. This does not bode well for the future. If anything, experience with the Asian clam and the zebra mussel has shown the potentially high costs of delaying action on new invasions.

#### A Serious Weed of Wetlands -- Purple Loosestrife

Sometimes efforts to prevent or manage severely harmful non-indigenous species are impeded by those who see the same species as beneficial. Purple loosestrife (*Lythrum salicaria*) is an example. This wetlands plant of Eurasian origin arrived in the United States shortly following European colonization. Its seeds were inadvertently carried in the dry ballast of ships--dirt, gravel, debris, and the like--then discarded at U.S. ports. Purple loosestrife had become well-established throughout the northeastern United States by the mid-1800's and had spread to twenty-three States by 1940. Today, its occurrence in wetlands of at least thirty-eight States is called an "ecological disaster" by some scientists. Nevertheless, the plant is widely sold in nurseries for use in gardens.

Purple loosestrife clearly illustrates how the perceived effects of a non-indigenous species can vary with the eye of the beholder. To managers of natural areas it is highly damaging because it grows prolifically, displaces indigenous plants, and provides lower quality habitat and food for wild animals. In contrast, some horticulturists in the nursery trade see purple loosestrife as a desirable plant because of its color and form.

This duality--where a species has harmful and positive impacts--complicates the decisionmaker's role for many non-indigenous species. Deciding whether and how a species can be used is especially problematic for plants like purple loosestrife where the economic benefits are clear, but the harmful impacts on natural ecosystems defy easy analysis. It may account for why various government agencies and private organizations continue to promote plants that can invade natural areas for applications like soil conservation.

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Only a few States, like Illinois, Minnesota and Washington, have moved to protect their natural areas from purple loosestrife. The State of Minnesota spent some \$500,000 between 1987 and 1991 on control. Meanwhile, the response at the Federal level has been disjointed. Agencies like the U.S. Fish and Wildlife Service and the Bureau of Reclamation are attempting to control purple loosestrife. Nevertheless, the species remains one of several prominent weeds of natural areas currently not listed under the Federal Noxious Weed Act and therefore not subject to Federal restrictions on importation and interstate transport. The story of purple loosestrife demonstrates a general problem. Some harmful non-indigenous species will not be effectively controlled until we find a way of dealing with conflicting views of their value and effects.

#### An Impending Threat to U.S. Forests -- Asian Gypsy Moth

The nation can expect a continuing need to respond to new introductions and constantly changing pathways. The Asian gypsy moth (*Lymantria dispar*) provides a clear example of why this is so.

In 1991, Asian gypsy moths were detected in the State of Washington. The insects had arrived on grain ships from eastern Russia. Joint action by the Washington State and U.S. Departments of Agriculture successfully eradicated the outbreak at a cost of between \$14 and \$20 million. Nevertheless, the incident raised the specter of a new devastating forest pest threatening the valuable timber resources of the Pacific Northwest. One Washington State official said the Asian gypsy moth "has the potential to be the most serious exotic insect ever to enter the United States" And the U.S. Department of Agriculture estimated the costs of the Asian gypsy moth and another tree defoliator (the nun moth--*Lymantria monacha*) could reach \$35 to \$58 billion.

The Asian gypsy moth is closely related to the European gypsy moth that is already well-established in the United States. The latter has been defoliating trees in a growing area of the eastern United States for over 120 years following its unintentional release by a

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researcher in Massachusetts. A number of Federal and State programs address the European gypsy moth's continuing threat. And a Federal quarantine restricts interstate transport of items that might carry the insect, like firewood and recreational vehicles. These efforts are not completely successful. The U.S. Forest Service estimates that, in 1990, despite a suppression program costing approximately \$20 million, the European gypsy moth defoliated an estimated 7.4 million acres nationwide.

The U.S. experience with the European gypsy moth highlights the difficulty of eradicating certain pests once they become well-established. The case of the Asian gypsy moth shows, in contrast, that rapid and effective action can sometimes stop a newly arrived pest. However, the same Federal agencies that reacted promptly to the Asian gypsy moth's detection were slow to respond to a potentially significant new pathway for its entry that emerged in 1990 when private companies moved to begin importing timber from Siberia. Vigilance is needed in both areas; the problems are unlikely to get any easier as the movement of people and goods around the globe increases.

#### An Introduction Under Control? -- Grass Carp

The grass carp (*Ctenopharyngodon idella*), originally from Asia, shows how even the most well-intended introductions can have unexpected negative consequences. The U.S. Fish and Wildlife Service's laboratory in Stuttgart, Arkansas and Auburn University (Alabama) brought the fish into the United States in 1963. The intent was to provide a new biological control agent to reduce growth of aquatic weeds like hydrilla which pose a navigation hazard and reduce the productivity of recreational fisheries. Since then, grass carp have been widely propagated and released throughout the country.

However, the grass carp is not a wholly beneficial introduction. The fish are almost too effective at their task. They indiscriminately consume aquatic vegetation, destroying habitats for young fish, increasing water turbidity, and causing deterioration of waterfowl

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habitats. While of low concern in artificial environments such as irrigation systems, grass carp can seriously disrupt natural ecological communities. Moreover, imports of infected grass carp are thought to have been the source of the Asian tapeworm (*Bothriocephalus oparichthydis*), a parasite that has been found infecting several indigenous North American fishes, including the endangered Colorado squawfish.

The current solution to balancing the grass carp's risks against its benefits has been to sterilize the fish. Special techniques are used to make them triploid--that is, having three sets of chromosomes rather than the normal complement of two. Tests are then available to certify fish triploidy. But, even triploid grass carp need to be introduced with caution. As noted by the Florida Agricultural Experiment Station in a brochure promoting use of the fish, individuals can live as long as ten years and attain a weight of forty pounds, and the fish are extremely difficult to remove from water bodies once introduced.

Regulating fish releases is largely a State responsibility under current laws and policies. Although the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 was designed to help prevent unintentional harmful introductions, the interagency task force it created has interpreted introductions related to aquaculture--including fish escapes--as intentional and thus beyond the Act's general purview. The States for their part vary greatly in how they have chosen to deal with the grass carp. Many require certification of triploidy for any grass carp transported to within their borders. The U.S. Fish and Wildlife Service supports this effort by operating a triploidy inspection service. Nevertheless, State regulation is by no means uniform. Some have no triploidy requirements. Releases of reproductive grass carp in States where they are not regulated are thought to be the source of free-living populations now found in the Mississippi River. The moral here is that it is can be very difficult to keep live organisms under lock and key, especially with inconsistent controls over their use and release.

Summary

Unfortunately, the United States is well experienced with harmful non-indigenous species. I have described just six of these today. While such harmful species have exacted a significant toll, they also provide a wealth of data. These point the way to the key questions that need to be asked before future introductions, such as that of the black carp.

## OTA TESTIMONY

TESTIMONY OF PHYLLIS N. WINDLE, SENIOR ASSOCIATE,  
OFFICE OF TECHNOLOGY ASSESSMENT, U.S. CONGRESS

ACCOMPANIED BY PETER JENKINS, CONTRACTOR<sup>1</sup>

SUBMITTED TO THE UNITED STATES HOUSE OF REPRESENTATIVES  
COMMITTEE ON MERCHANT MARINE AND FISHERIES

Subcommittee on Environment and Natural Resources  
Subcommittee on Fisheries Management

October 5, 1993

HARMFUL NON-INDIGENOUS SPECIES IN THE UNITED STATES

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<sup>1</sup> Analyst, Office of Technology Assessment, December 1990 to December 1992.



Congress of the United States  
Office of Technology Assessment  
Washington, DC 20510-0025

"Ecological roulette." "Biological pollution." "Alien invaders." These are all terms used to describe harmful non-indigenous species -- those species beyond their natural geographic ranges. Biologists coined these terms to describe an economic and environmental problem that is snowballing due to a lack of effective national and State action.

Thank you, Mr. Chairmen. I am Dr. Phyllis Windle from the Office of Technology Assessment. With me today are Dr. Elizabeth Chornesky and Mr. Peter Jenkins, who worked closely with me on the new OTA study that we are here to discuss. You asked us to discuss the:

- economic costs, or impacts;
- impacts on native habitats;
- threat of continuing introductions; and
- adequacy of Federal and State laws, all related to harmful non-indigenous species.

Also, we will summarize information regarding possible intentional releases of the Asian black carp (*Mylopharyngodon piceus*) to control zebra mussels.

If your district is agricultural, probably 50-75% of your weeds are non-indigenous and your constituents suffered some of the estimated \$3.6 to 5.4 billion in crop loss and herbicide costs per year nationwide. If your district contains a wildlife refuge, a State or National Park, or other natural area, it is almost certain that it has some problems with harmful NIS and that it is short of resources to manage them successfully. If your constituents own pets, travel overseas, fish, hunt, or garden, the issues we discuss today affect every one of them directly.

## ECONOMIC IMPACTS

Over one-half of the trees and shrubs you see on the Capitol grounds are not indigenous to the United States. They, like almost all our crops, many sport fish, and most biological control agents, provide substantial economic, aesthetic, and other benefits.

Harmful NIS, however, cause substantial cumulative economic losses. In OTA's judgment, these economic effects are likely to climb. Troublesome species that have already reached the United States are rarely eliminated from the country, while new ones are constantly added. As a result, the cumulative number of foreign NIS is steadily and swiftly growing.

At least 4,500 NIS of foreign origin have established free-living populations in the United States, a much larger number than was present 100 years ago. Approximately 15% of the species trigger severe harm. Thus, we know that there are several hundred species causing sizable harm throughout the country. Almost every part of the country faces at least one highly damaging NIS --like the zebra mussel, gypsy moth, or leafy spurge (a weed).

Most species' economic impact is not recorded. From 1906-1991, just 79 harmful NIS caused documented cumulative losses of \$97 billion, mostly in control costs and direct losses of marketable goods. The total includes only 14% of the species known to be harmful and excludes one of the most costly groups: agricultural weeds. This figure likely represents only a fraction of the total costs because so many species and kinds of effects are uncounted. The following examples indicate the kind of impacts a single species can have:

- The boll weevil has the highest documented impacts -- at least \$50 billion cumulatively for 1909-1949.
- The medfly in California costs up to \$897 million annually in damaged produce, control efforts, and reduced value of exports during years of its repeated outbreaks.
- The European gypsy moth caused \$764 million in forest and other losses in 1981, an all-time high.

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- The alfalfa weevil caused \$500 million in losses in 1990.
- Removal of salt cedar along the lower Colorado River and restoration of indigenous vegetation is estimated at \$45 to \$450 million.
- In 1990, the weed leafy spurge caused direct losses of livestock production of \$110 million over 1.5 million acres in the northern Great Plains.
- \$100 million is spent nationally for controlling aquatic weeds, the majority of which are non-indigenous.
- Unless it is controlled, the European ruffe could cause losses of \$90 million.
- \$10 million is spent annually for sea lamprey control and research. This prevents losses to fishing and other economic impacts estimated at \$500 million annually.

With single species costing from \$10 million to nearly \$900 million annually, we can conservatively estimate that harmful NIS annually cause losses of hundreds of millions of dollars for agriculture, fisheries, forests, and rangelands. Losses can reach several billion dollars in high-impact years. A worst case scenario for 15 high-impact species adds another \$134 billion in potential future economic losses, or impacts. Harmful NIS also exact an often uncounted toll on other industries, human health, protection of natural areas, and secondary effects.

#### **IMPACTS ON NATIVE HABITATS**

Populations of many NIS expand rapidly in new habitats where their former competitors, predators, pathogens and parasites no longer keep them in check. In the process, they can threaten indigenous species and transform native U.S. ecosystems.

The popular press and environmentalists frequently stress the role of NIS in species extinctions but much of the supporting evidence is anecdotal or equivocal.

Overemphasizing extinctions tends to divert attention from other significant and unambiguous environmental damage. Biological communities can be radically and permanently altered without extinctions occurring. And the United States can experience a significant decline in the abundance, diversity, and aesthetic value of its indigenous species, also without extinctions. Both kinds of changes are common now.

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**Declines of indigenous species** -- The decline of a number of indigenous species has been attributed to NIS. The diversity of species affected and the breadth of the impacts are warning signs of the growing impact of harmful NIS across the country.

- In Hawaii, NIS now make up at least one-half of the State's wild plants and animals.
- The balsam wooly adelgid has killed almost all the adult fir trees in Great Smoky Mountains National Park, formerly the repository of about 74% of all spruce-fir forests in the southern United States.
- Mosquitofish have been associated with localized declines in at least 15 indigenous fishes in desert rivers and springs.
- At least 10 indigenous plants are less common in parts of Arizona where African lovegrass occurs.
- Non-indigenous house sparrows and European starlings have caused dramatic declines of eastern bluebirds and other indigenous birds.
- The non-indigenous rusty crayfish caused the local disappearance of an indigenous crayfish in several Wisconsin lakes in the 1980s.

A single harmful NIS can harm a host of indigenous species. Chestnut blight virtually eliminated stands of American chestnuts, roughly 25 percent of the trees in about 91 million hectares of eastern forests. In turn, the chestnuts' loss is thought to be responsible for at least 5 indigenous insect species' disappearance and to have contributed to the increase in oak wilt disease as red oaks replaced chestnut trees.

**Transformations of ecosystems** -- The worst NIS are capable of transforming entire ecosystems. Some, like the chestnut blight, radically shift species composition. Others, like the zebra mussel, drastically modify an ecosystem's basic physical and chemical features.

For example:

- The Australian melaleuca tree is rapidly degrading the Florida Everglades wetlands system by replacing sawgrass marshes, forests, and other natural habitats with single species stands that provide poorer habitat for wildlife.
- Two non-indigenous grasses now comprise 80 percent of the plant cover in parts of Hawaii Volcanoes National Park -- grasses that have increased the frequency of brush fires in the Park and offset normal ecological processes.

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- Wild hogs that escaped from hunting enclosures disturb 50 species of plants, displace small animals, and increase soil erosion in Great Smoky Mountains National Park.
- The recent introduction of the opossum shrimp in the Flathead River-Lake ecosystem in Glacier National Park had a series of effects like a line of falling dominoes -- eventually driving away the area's fish predators -- including eagles, otters, coyotes, and bears.

As these examples indicate, National Parks are experiencing problems with NIS in spite of restrictive policies and eradication efforts. There is increasing concern that the threats from NIS in some areas are so severe that Park ecosystems will be permanently altered if large-scale control and eradication efforts are not undertaken. The same is true for some State parks. A 1991 study concluded, for example, that harmful NIS are among the 10 most serious and widespread threats to Missouri's State parks.

**Species extinctions** -- The worst NIS have also caused species extinctions.

The introduction of NIS has been closely correlated with the disappearance of indigenous species in Hawaii and other islands. Biological control agents in Hawaii have been implicated in the loss of 15 indigenous moth species. In Guam, the brown tree snake is believed to have caused extinctions of 5 species or subspecies of birds and declines of numerous others; if it reaches Hawaii, its effects would probably be similar. As of 1991, the U.S. Fish and Wildlife Service considered NIS to be a contributing factor in listing 160 species as threatened or endangered, or, on average, roughly 25 percent of all listings. Harmful NIS are considered *the* major cause of listing for 41 of these species, 23 of which are from from Hawaii or Puerto Rico. These constitute about 7 percent of all listings.

Even indigenous species on the U.S. mainland can be pushed to dangerously low levels when harmful NIS act in concert with other stresses such as pollution or habitat destruction. For example, the combination of extensive water projects and the introduction of species better adapted to such altered habitats is considered the major cause of drops in California's indigenous fish, 76 percent of which are declining, threatened, endangered, or extinct.

### THE THREAT OF CONTINUING INTRODUCTIONS

Naturally occurring movements of species into the United States are rare. Most organisms arrive with human help. Numerous NIS entered the country as unintended contaminants of commodities, packing materials, shipping containers, or ships' ballast. Others were intentionally imported as crops, ornamental plants, livestock, pets, or aquaculture species -- and later escaped. For example, at least 36 of the West's 300 weeds escaped from horticulture or agriculture. A number of NIS were introduced to improve soil conservation, fishing and hunting, or biological control but caused unexpected harm.

This process continues today. Just since 1980, some 200 foreign species were first introduced or detected. At least 59 of these are expected to be harmful here.

Uncertainty in predicting types and levels of risk remains a problem. Past intentional and accidental fish and wildlife introductions, for instance, have had about equal chances of turning out badly. Uncertainty can be reduced, or at least be made explicit, using methods such as risk analysis, benefit/cost analysis, environmental impact assessment, and decisionmaking protocols.

For some species, prevention is the best strategy. However, port inspection and quarantine are fallible, with diminishing returns above a certain point. Also, some organisms are more easily controlled than intercepted. So aiming for a standard of "zero entry" is unrealistic, especially if prevention comes at the expense of control.

### THE ADEQUACY OF FEDERAL AND STATE LAWS

As the black carp illustrates, we will continually be faced with assessing potential new importations and releases. Right now, Federal and State laws are inadequate to ensure the Nation's protection from the species likely to be harmful.

The Federal Government has responded to harmful NIS with a largely uncoordinated patchwork of laws, regulations, policies and programs. Many only address NIS peripherally, whereas others address the more narrowly drawn problems of the past. At least 20 Federal

agencies are involved, with the U.S. Departments of Agriculture and Interior playing the largest roles. Federal laws leave both obvious and subtle gaps that most States do not fill adequately. Significant gaps exist for non-indigenous fish, wildlife, animal diseases, weeds, vectors of human diseases, and species in natural areas. Many of these gaps also apply to genetically engineered organisms because they and NIS are commonly regulated under the same laws.

Federal agencies manage about 30% of the Nation's lands, many with grim NIS problems. Yet Federal management policies are often inconsistent or inadequate. Federal and State agencies cooperate on many programs related to agricultural pests, but their policies can also conflict, e.g., when different agencies manage adjacent lands. Sometimes Federal law preempts State law, more often regarding agriculture than fish and wildlife. Conflicts between States also occur, often without forums for resolving disputes.

State laws are relatively complete for agricultural pests but spotty for invertebrate and plant pests of nonagricultural areas. The State role is most critical for the import and release of fish and wildlife, where there is less Federal presence. States' fish and wildlife laws use a variety of approaches and vary from lax to exacting. Many such laws are weak and inadequately implemented; others, however present exemplary approaches related, for example, to burdens of proof prior to releases and controlling escaped animals.

Harmful NIS have hit Hawaii and Florida particularly hard because of their distinctive geography, climate, history, and economy. Cooperative efforts have sprung up in both places. Increasingly, State and Federal agencies, nongovernmental organizations, agricultural interests, and universities see harmful NIS as a unifying threat and public education as an important tool to alleviate it.

Congress could take a number of specific actions to improve U.S. management of harmful NIS. These might include amendments to the Lacey Act and the Federal Noxious Weed Act. Congress might require stricter screening for invasiveness for federally funded

efforts using NIS. Congress could direct additional funds to weed management on public lands and to resource management in the National Parks and other protected areas. Congress could expand environmental education and provide Federal agencies with adequate authority for emergency treatment of early NIS infestations.

Imposing new responsibilities without providing money for them does not work, as has been shown by the experience of the Federal interagency Aquatic Nuisance Species Task Force. Entrance or user fees could fund more rigorous and scientific decisionmaking and additional control. Fines, levied on those who bring harmful NIS into the country or spread them to new States, could more closely match the real costs of publicly funded management. Federal policy cannot succeed without State help. Model State laws or national minimum standards could ensure that all States have authority to regulate harmful NIS adequately.

#### CONCLUSION

Non-indigenous species are here to stay and many of them are welcome. Problems due to harmful species, however, are likely to worsen. Human migration and population growth, increasing trade and travel, and, possibly, climate change propel species' movements. Countervailing trends -- toward stricter screening and more sophisticated control -- are weaker.

Better management of harmful NIS will save us money. And better management of damaging NIS will protect the services that indigenous ecological systems provide. But there is another issue ripe for public discourse.

Whether you drive west from Washington on Interstate 66 or north on Interstate 95, teasel, Queen Anne's lace, and tree-of-heaven will be prominent roadside plants for hundreds of miles. In any city in the United States, you will see starlings and English sparrows. None of these species is indigenous.

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The richness of our cultural heritage is in the details -- Boston baked beans and San Francisco sourdough bread; the theater district in New York City and the skyscraper architecture of Chicago; Amish quilts from Pennsylvania and Navaho rugs from Arizona; rap, salsa, and cowboy music from their own particular locales. Some of these traditions developed here and others are the equivalent of introductions of beneficial NIS. In the same way, our country possesses a diverse, rich, and unique biological heritage. Many fear that our failure to adequately address the problems of harmful NIS will lead to a highly homogenized world. In the process, they fear, we will squander the biological heritage of our country.

Now I would like to turn to Dr. Elizabeth Chornesky. She will describe a few case studies of harmful introductions. Then I will summarize what we have found regarding the black carp.

\* \* \* \*

#### THE ASIAN BLACK CARP

One test of this assessment's usefulness is whether it can guide evaluations of a new species potential introduction. After you asked about the black carp, we have been in touch with about a dozen fishery experts and aquaculturists, combed our assessment for lessons that would apply, and combined what we know of this and similar fish, here and abroad. We hope that our assessment will enable your staff to do the same for other species for several years to come.

**Background** -- The black carp is similar to other carps already introduced to the United States. Generally, little is known about its food preferences, although it seems to prefer eating snails and clams. In Israeli reservoirs, the fish feed first on snails, then, when snail populations decline, it eats insect larvae and shrimp. U.S. research and fish culture is just beginning. Several aquaculture facilities are ready or nearly ready to spawn black carp. The Sea Grant Program at North Carolina State University has ordered 5,000 triploid black

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carp from Arkansas for experiments on controlling the yellow grub, a pest that causes significant fish losses. They have the State's permission to distribute triploid black carp to 10 to 11 fish growers with approximately 200 acres of aquaculture ponds. Right now, there is no evidence, only speculation, on using black carp to control zebra mussels.

**Nature and Extent of Threats Posed by Introduction --** There are four main threats posed by this introduction. First, there is the threat that it would prove ineffective in controlling zebra mussels after its release. No evidence exists that it would prefer eating zebra mussels to other mollusks. Research on carp and zebra mussels is underway in the Danube River in Europe. Black carp did successfully control undesirable snails and Asian clams in Israel. However, managers aimed to eliminate all biological activity in reservoirs and the black carp successfully wiped out all snails. Similar snail control was not successful in open canals so it is not clear that black carp could successfully control mollusks in the more open waters and lakes where the zebra mussel is found. Many of these questions about feeding preferences are relatively straightforward to answer. Release of the black carp would be very risky until this kind of research is completed.

Second, there is the threat that black carp will eat indigenous mollusks. This seems a quite sizable threat. An estimated 71.7 percent of the 297 native freshwater mussels are endangered, threatened, or of special concern. Theoretically, black carp populations could be kept from reproducing by releasing only triploid fish. But black carp are large and long-lived. In their native China, they can live for 20 years and usually weigh 50-65 pounds, although one reached 150 pounds. Even non-reproducing populations could consume large quantities of indigenous and/or non-indigenous mollusks.

Third, there is the threat that reproducing populations will be formed, either through escape of diploid organisms or reversion of triploid fish to diploid. Reversion to diploid seems possible but not probable, based on similar concerns regarding Japanese oysters in the Chesapeake Bay. The triploid grass carp program appears quite successful at ensuring

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triploidy. Growers claim that efforts to create triploid black carp are similarly successful. On the other hand, diploid populations of the black carp are now housed in aquaculture facilities or laboratories in at least 2 States. Some growers would like to produce it for food consumption, regardless of its use for biological control. The Federal interagency Aquatic Nuisance Species Task Force concluded that the likelihood of eventual escape is so great that aquaculture species should be considered intentional introductions. Therefore, it seems that escape of diploid fish from aquaculture must be considered highly probable. However, many of the larger bodies of water where the black carp might be used for biological control may not have the conditions required for its successful reproduction.

Fourth, there is the threat that black carp will have additional unpredictable and harmful effects. This is a possibility for any new species' release but especially so for fish. Past intentional fish introductions have turned out badly slightly more often than unintentional ones, providing little reassurance about our ability to predict accurately the harm of new releases. Black carp has close relatives -- the grass carp and silver carp -- that have already shown a propensity for unconsidered harmful effects after introduction.

**Authority to Regulate the Black Carp's Importation and Release** -- There is little authority under Federal law to regulate the black carp. Any fish and wildlife species can be legally imported unless it is listed as injurious by the federal Lacey Act. Thus, aquaculturists were able to import black carp into Missouri and Arkansas without Federal scrutiny. Vertebrate biological control agents often are not carefully screened prior to release. No comprehensive Federal laws ensure their effectiveness, although the Lacey Act requires that shipments be labelled accurately.

State laws would be the primary vehicle for regulating black carp, as for other fish and wildlife. Yet, according to OTA's analysis, 5 States (Iowa, North Dakota, New Jersey, Wisconsin, and Mississippi) lack legal authority to regulate either the importation or release of fish. The other States' regulatory approaches vary widely. Only Hawaii prohibits



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all new importations and releases unless the species is listed on a "clean" -- or allowable -- list of species. At least 11 States have the legal authority in place but lack any prohibitions on introductions of specific harmful fish species. At least 12 States face the same situation regarding fish releases. The remaining States do prohibit some species, including the grass carp.

In a letter to the *Water Farming Journal* and copied to black carp growers, the Aquatic Nuisance Species Task Force emphasized the need for thoroughly evaluating proposed biological control agents, a careful environmental assessment of potential impacts, and ensuring that no escapes occur. In most States, such activities would be voluntary. About 17 States have no specific decisionmaking standards for importations of fish; 15 have no decisionmaking standards for fish releases. No State requires a scientifically based protocol such as that developed by the American Fisheries Society. But 18 States have "little NEPA's", i.e., statutes, regulations, or executive orders that could require more stringent environmental impact assessment.

In our study, we identified several exemplary approaches that different States use for fish and wildlife regulation. The provisions that most apply in this case are: imposing adequate burdens of proof of benefit before importation or release is permitted; requiring expert input into decisions; planning for the control and damages of any escapees; providing for emergency rule-making on newly perceived threats; and having sanctions against those who violate laws and incentives for those who comply. Overall, many States fall short in these areas. This does not bode well for careful assessment and regulation of a fish as potentially damaging to indigenous snails as the black carp.

**Conclusion --** The jury is still out. The black carp might control the Asian clam, even if not the zebra mussel. It might be useful against a variety of damaging mollusks in carefully confined water bodies. Also, it might be a profitable food fish. Now, however, the only advocates for its release are the growers who hope to sell it. On the other hand,

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fishery experts have described the black carp's potential release in dire terms: "A potential disaster of the first order," "Absolutely ridiculous," "Absolutely not." If we have learned anything during the course of this study, it is that releases need to be evaluated with more care than in the past. Right now, no database exists to adequately assess whether the black carp would, on balance, be more beneficial than harmful.

We will be pleased to answer your questions. Mr. Peter Jenkins is well-versed on fish and wildlife issues generally and State laws and regulations in particular.



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